CLAIMS

We claim:

1. A process for producing crystalline III-V compound films on crystal substrates, the process comprising the steps of:

(a) depositing an amorphous layer of a III-V compound precursor on a crystal substrate;

(b) reacting the amorphous layer with a reduced form of a Group V element; and

(c) after the reacting step, heating the amorphous layer at a temperature and for a time sufficient to crystallize said amorphous layer by pyrolysis.

2. The process of claim 1, in which the depositing step comprises depositing the amorphous layer by coating the crystal substrate with a solution of the III-V compound precursor.

3. The process of claim 1, in which the depositing step comprises depositing the amorphous layer by spin coating a solution of the III-V compound precursor.

4. The process of claim 1, in which the crystal substrate is a single crystal substrate.

5. The process of claim 1, in which the reacting step and the heating step are carried out simultaneously.

6. The process of claim 1, in which the III-V compound precursor is a III-V nitride precursor.

7. The process of claim 6, in which the III-V nitride precursor is a Group III-dimethyl amide.

8. The process of claim 6, in which the III-V nitride precursor is an oxygen-containing Group III salt.

9. The process of claim 6, in which the III-V nitride precursor is an oxygen-containing Group III alkoxide.

10. The process of claim 6, in which the reduced form of the Group V element is NH_3.

11. The process of claim 6, in which the III-V nitride precursor is a gallium nitride precursor.

12. The process of claim 11, in which the gallium nitride precursor is gallium dimethyl amide.

13. The process of claim 12, in which the reacting step comprises reacting the amorphous layer with NH_3 so that carbon groups are removed from gallium dimethyl amide.

14. The process of claim 12, in which the heating step comprises heating the amorphous layer in a N_2 or NH_3 atmosphere.

15. The process of claim 12, in which the heating step comprises heating the amorphous layer at a temperature preferably between 900°C – 1100°C.

16. The process of claim 12, in which the crystal substrate is a single crystal substrate selected from the group consisting of C-plane (0001) Al_2O_3, r-plane (01-12) Al_2O_3, r-plane Al_2O_3, (001) $LiGaO_2$ and (100) $LiAlO_2$.

17. The process of claim 12, in which the crystal substrate is C-plane (0001) Al_2O_3.

18. The process of claim 12, in which the crystal substrate is r-plane (01-12) Al_2O_3.

19. The process of claim 11, in which the gallium nitride precursor is an oxygen-containing gallium salt.

20. The process of claim 19, in which the oxygen-containing gallium salt is gallium nitrate.

21. The process of claim 11, in which the gallium nitride precursor is an oxygen-containing gallium alkoxide.

22. The process of claim 21, in which the oxygen-containing gallium alkoxide is gallium isopropoxide.

23. The process of claim 20 or 22, in which the crystal substrate is a single crystal substrate selected from the group consisting of C-plane (0001) Al_2O_3, r-plane (01-12) Al_2O_3, r-plane Al_2O_3, and SiC.

24. The process of claim 20 or 22, in which the crystal substrate is C-plane (0001) Al_2O_3.

25. The process of claim 20 or 22, in which the crystal substrate is (01-12) Al_2O_3.

26. The process of claim 20 or 22, in which the heating step comprises heating the amorphous layer in an NH_3 atmosphere.

27. The process of claim 20 or 22, in which the heating step comprises heating the amorphous layer at a temperature preferably between 900°C – 1100°C.

28. The process of claim 20 or 22, in which the reacting step and the heating step are carried out simultaneously.

29. A process for producing crystalline gallium nitride thin films on a crystal substrate, the process comprising the steps of:

(a) depositing an amorphous layer of gallium dimethyl amide by spin coating a solution of gallium dimethyl amide on a single crystal substrate;

(b) reacting the amorphous layer with NH_3 so that carbon groups are removed from the amorphous layer of gallium dimethyl amide; and

(c) after the reacting step, heating the amorphous layer in a N_2 or NH_3 atmosphere at a temperature and for a time sufficient to crystallize the amorphous layer by pyrolysis.

30. A process for producing crystalline gallium nitride thin films on a crystal substrate, the process comprising the steps of:

(a) depositing an amorphous layer of a gallium nitride precursor by spin coating a solution of gallium nitrate or gallium isopropoxide on a single crystal substrate;

(b) reacting the amorphous layer with NH_3 so that the amorphous layer is reduced and subject to nitridation; and

(c) simultaneously with the reacting step, heating the amorphous layer in an NH_3 atmosphere at a temperature and for a time sufficient to crystallize the amorphous layer by pyrolysis.